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Interventions and Management

1. Efficacy of rehabilitation physiotherapy combined with brace correction in patients with mild to moderate scoliosis secondary to cerebral palsy

Zhen Yang, Qiping Liu, Yongyan Bi, Yongping He, Miaomiao Wang, Qiang Gao, Lian Xiang, Xiaoliu Li

J Back Musculoskelet Rehabil. 2024 Jun 26. doi: 10.3233/BMR-230336. Online ahead of print.

Background: Scoliosis secondary to cerebral palsy is one of the common complications of cerebral palsy in children with cerebral palsy. **Objective:** This study aimed to explore the efficacy of rehabilitation combined with brace correction in patients with scoliosis secondary to cerebral palsy. **Methods:** A total of 52 patients with scoliosis secondary to cerebral palsy were selected from our hospital from April 2019 to April 2022 and divided into the control group and experimental group according to the statistical randomization method (n= 26 in each group). **Control group:** mean age (14.28 ± 2.31) years; 16 males and 10 females. **Experimental group:** average age (14.24 ± 2.35) years; 15 males and 11 females. The control group wore scoliosis orthopedic brace, while the experimental group was treated with rehabilitation manipulation and rehabilitation training (including gymnastic training and weight training) on the basis of the control group for 1 year. The clinical efficacy of the two groups was compared and observed; the number of degrees of scoliosis (Cobb angle), the angle of vertebral rotation (AVR) and the distance of the parietal vertebrae from the sacral midline (AVT) were compared before and after treatment; the incidence of adverse events during treatment was observed in the two groups. **Results:** After treatment, both groups showed significant improvement in the overall effectiveness of treatment, Cobb's angle, AVR and AVT compared with those before treatment (P< 0.05). The experimental group had a significantly higher overall effective rate of treatment than the control group (P< 0.05), a significantly smaller Cobb's angle and AVR than the control group (P< 0.05) and a significantly shorter AVT than the control group (P< 0.05). The incidence of adverse events during treatment was lower in both groups and was not significantly different (P> 0.05). **Conclusion:** The combination of rehabilitation physiotherapy and bracing is effective in optimizing the clinical outcome of patients with scoliosis secondary to cerebral palsy, improving their scoliosis dysfunction and providing a high level of safety in treatment.

PMID: [39269817](https://pubmed.ncbi.nlm.nih.gov/39269817/)

2. Postural Stability in Children with Cerebral Palsy

Andrzej Szopa, Małgorzata Domagalska-Szopa

J Clin Med. 2024 Sep 5;13(17):5263. doi: 10.3390/jcm13175263.

Background: A lack of postural control is one of the key problems in children with cerebral palsy (CP). The goals of the present study were to assess static postural stability in children with mild CP using a force platform compared to that of typically developing peers and to identify differences in static stability between children with hemiplegic and diplegic CP. **Methods:** This study included 45 children with hemiplegic CP and 45 children with well-functioning diplegic CP (Gross Motor Function Classification System; GMFCS scores between I and II) who were patients of local paediatric rehabilitation centres. The testing procedure included two interrelated parts: (1) the analysis of the body weight distribution and (2) the posturometric test (the centre of pressure; CoP measurements) using the force platform. **Results:** The results of the present

study show that children with CP, compared to their TD peers, demonstrated significantly higher values for all of the analysed indexes of postural stability. The obtained results indicate differences in disorders of static postural stability between children with hemiplegic and diplegic CP. Compared to their TD peers, children with hemiplegic CP showed greater body weight asymmetry between the affected and unaffected sides of the body and greater CoP sway in the medial-lateral direction. In contrast, children with diplegic CP exhibited greater CoP displacements in the anterior-posterior direction. Conclusions: The findings of the present study show that (1) children with CP have increased static postural instability compared to their TD peers and (2) children with diplegic CP exhibit weaker mediolateral stability in standing, whereas children with hemiplegic CP show reduced anterior-posterior stability.

PMID: [39274473](#)

3. Depth-Sensing-Based Algorithm for Chest Morphology Assessment in Children with Cerebral Palsy

Olivera Tomašević, Aleksandra Ivančić, Luka Mejić, Zorana Lužanin, Nikola Jorgovanović

Sensors (Basel). 2024 Aug 28;24(17):5575. doi: 10.3390/s24175575.

This study introduced a depth-sensing-based approach with robust algorithms for tracking relative morphological changes in the chests of patients undergoing physical therapy. The problem that was addressed was the periodic change in morphological parameters induced by breathing, and since the recording was continuous, the parameters were extracted for the moments of maximum and minimum volumes of the chest (inspiration and expiration moments), and analyzed. The parameters were derived from morphological transverse cross-sections (CSs), which were extracted for the moments of maximal and minimal depth variations, and the reliability of the results was expressed through the coefficient of variation (CV) of the resulting curves. Across all subjects and levels of observed anatomy, the mean CV for CS depth values was smaller than 2%, and the mean CV of the CS area was smaller than 1%. To prove the reproducibility of measurements (extraction of morphological parameters), 10 subjects were recorded in two consecutive sessions with a short interval (2 weeks) where no changes in the monitored parameters were expected and statistical methods show that there was no statistically significant difference between the sessions, which confirms the reproducibility hypothesis. Additionally, based on the representative CSs for inspiration and expirations moments, chest mobility in quiet breathing was examined, and the statistical test showed no difference between the two sessions. The findings justify the proposed algorithm as a valuable tool for evaluating the impact of rehabilitation exercises on chest morphology.

PMID: [39275488](#)

4. Predicting Steady-State Metabolic Power in Cerebral Palsy, Stroke, and the Elderly During Walking With and Without Assistive Devices

Karl Harshe, Benjamin C Conner, Zachary F Lerner

Ann Biomed Eng. 2024 Sep 8. doi: 10.1007/s10439-024-03614-w. Online ahead of print.

Purpose: Individuals with walking impairment, such as those with cerebral palsy, often face challenges in leading physically active lives due to the high energy cost of movement. Assistive devices like powered exoskeletons aim to alleviate this burden and improve mobility. Traditionally, optimizing the effectiveness of such devices has relied on time-consuming laboratory-based measurements of energy expenditure, which may not be feasible for some patient populations. To address this, our study aimed to enhance the state-of-the-art predictive model for estimating steady-state metabolic rate from 2-min walking trials to include individuals with and without walking disabilities and for a variety of terrains and wearable device conditions. Methods: Using over 200 walking trials collected from eight prior exoskeleton-related studies, we trained a simple linear machine learning model to predict metabolic power at steady state based on condition-specific factors, such as whether the trial was conducted on a treadmill (level or incline) or outdoors, as well as demographic information, such as the participant's weight or presence of walking impairment, and 2 minutes of metabolic data. Results: We demonstrated the ability to predict steady-state metabolic rate to within an accuracy of $4.71 \pm 2.7\%$ on average across all walking conditions and patient populations, including with assistive devices and on different terrains. Conclusion: This work seeks to unlock the use of in-the-loop optimization of wearable assistive devices in individuals with limited walking capacity. A freely available MATLAB application allows other researchers to easily apply our model.

PMID: [39245696](#)

5. Reliability of a Photo-Based Modified Foot Posture Index (MFPI) in Quantifying Severity of Foot Deformity in Children With Cerebral Palsy

Andrew G Georgiadis, Jon R Davids, Christine M Goodbody, Jason J Howard, Mara S Karamitopoulos, Monica Payares-Lizano, Kristan A Pierz, Jason T Rhodes, Benjamin J Shore, M Wade Shrader, Sean A Tabaie, Rachel Mednick Thompson, Beltran Torres-Izquierdo, Robert Lane Wimberl, Pooya Hosseinzadeh; Research in Neuromuscular Orthopaedics (RINO) Study Group

J Pediatr Orthop. 2024 Sep 11. doi: 10.1097/BPO.0000000000002812. Online ahead of print.

Introduction: Children with cerebral palsy (CP) have high rates of foot deformity. Accurate assessment of foot morphology is crucial for therapeutic planning and outcome evaluation. This study aims to evaluate the reliability of a novel photo-based Modified Foot Posture Index (MFPI) in the evaluation of foot deformity in children with CP. **Methods:** Thirteen orthopaedic surgeons with neuromuscular clinical focus from 12 institutions evaluated standardized standing foot photographs of 20 children with CP, scoring foot morphology using the MFPI. Raters scored the standardized photographs based on five standard parameters. Two parameters assessed the hindfoot: curvature above and below the malleoli and calcaneal inversion/eversion. Three parameters assessed the midfoot and forefoot: talonavicular congruence, medial arch height, and forefoot abduction/adduction. Summary MFPI scores range from -10 to +10, where positive numbers connote planovalgus, whereas negative numbers connote a tendency toward cavovarus. Intra- and interrater reliability were calculated using a 2-way mixed model of the intraclass correlation coefficient (ICC) set to absolute agreement. **Results:** Feet spanned the spectrum of potential pathology assessable by the MFPI, including no deformity, mild, moderate, and severe planovalgus or cavovarus deformities. All scored variables showed high intrarater reliability with ICCs from 0.891 to 1. ICCs for interrater reliability ranged from 0.965 to 0.984. Hindfoot total score had an ICC of 0.979, with a 95% CI, 0.968-0.988 ($P < 0.001$). The forefoot total score had an ICC of 0.984 (95% CI, 0.976-0.991, $P < 0.001$). Mean total score by the MFPI was 3.67 with an ICC of 0.982 (95% CI, 0.972-0.990, $P < 0.001$). **Conclusions:** The photo-based MFPI demonstrates high intra- and interrater reliability in assessing foot deformities in children with CP. Its noninvasive nature and ease of use make it a promising tool for both clinical and research settings. MFPI should be considered as part of standard outcomes scores in studies regarding the treatment of CP-associated foot deformities. Level of evidence: Level V.

PMID: [39256907](#)

6. Repeatability of gait of children with spastic cerebral palsy in different walking conditions

Laure Everaert, Tjil Dewit, Catherine Huenaerts, Anja Van Campenhout, Luc Labey, Kaat Desloovere

J Biomech. 2024 Aug 31;176:112301. doi: 10.1016/j.jbiomech.2024.112301. Online ahead of print.

Three-dimensional gait analysis is the 'gold standard' for measurement and description of gait. Gait variability can arise from intrinsic and extrinsic factors and may vary between walking conditions. This study aimed to define the inter-trial and inter-session repeatability in gait analysis data of children with cerebral palsy (CP) who were walking in four conditions, namely barefoot or with ankle-foot orthosis (AFO), and overground or treadmill. Ten children with spastic CP (7♀; $9.9y \pm 3.5y$; GMFCS-level I-III) were included in this study. Overall, we found good to excellent intra-class correlation (ICC)-values and favourable standard error of measurement (SEM)-values for the inter-session Gait Profile Score (ICC = 0.85-0.98, SEM = 0.45-0.91°) and Gait Variable Scores (ICC = 0.85-0.99, SEM = 0.22-1.11°) for the lower-limb joints. Taking the total joint-range-of-motion into account, the knee joint showed the most repeatable motion (%SEM = 0.5-1.8 %), while ankle motions showed the lowest repeatability (%SEM = 0.8 %-3.0 %). For the continuous waveform data, only the ankle joint showed repeatability differences between walking conditions, namely, smaller SEM-values for the AFO-condition (mean inter-trial = 0.14°; mean inter-session = 1.121°) in comparison to the barefoot-condition (mean inter-trial = 0.55°; mean inter-session = 2.22°). For all the kinetic parameters, the treadmill conditions showed smaller SEM-values in comparison to the overground condition. In conclusion three-dimensional gait analysis was found to be reliable in all four walking conditions for children with CP. The resulting measurement errors can be used as a reference during clinical interpretations of gait analyses. Clinical trial registration number: Trial ID from an internationally recognized trial registry (ClinicalTrials.gov): NCT06355869.

PMID: [39265255](#)

7. The Small Step Early Intervention Program for Infants at High Risk of Cerebral Palsy: A Single-Subject Research Design Study

Ann-Kristin G Elvrum, Silja Berg Kårstad, Gry Hansen, Ingrid Randby Bjørkøy, Stian Lydersen, Kristine Hermansen Grunewaldt, Ann-Christin Eliasson

J Clin Med. 2024 Sep 6;13(17):5287. doi: 10.3390/jcm13175287.

Background/Objectives: Early interventions for infants at high risk of cerebral palsy (CP) are recommended, but limited evidence exists. Our objective was, therefore, to evaluate the effects of the family-centered and interprofessional Small Step early intervention program on motor development in infants at high risk of CP (ClinicalTrials.gov: NCT03264339). **Methods:** A single-subject research design was employed to investigate participant characteristics (motor dysfunction severity measured using the Hammersmith Infant Neurological Examination (HINE) and Alberta Infant Motor Scale (AIMS) at three months of corrected age (3mCA) related to intervention response. The repeated measures Peabody Developmental Motor Scales-2 fine and gross motor composite (PDMS2-FMC and -GMC) and Hand Assessment for Infants (HAI) were analyzed visually by cumulative line graphs, while the Gross Motor Function Measure-66 (GMFM-66) was plotted against reference percentiles for various Gross Motor Function Classification System (GMFCS) levels. **Results:** All infants ($n = 12$) received the Small Step

program, and eight completed all five training steps. At two years of corrected age (2yCA), nine children were diagnosed with CP. The children with the lowest HINE < 25 and/or AIMS ≤ 6 at 3mCA (n = 4) showed minor improvements during the program and were classified at GMFCS V 2yCA. Children with HINE = 25-40 (n = 5) improved their fine motor skills during the program, and four children had larger GMFM-66 improvements than expected according to the reference curves but that did not always happen during the mobility training steps. Three children with HINE = 41-50 and AIMS > 7 showed the largest improvements and were not diagnosed with CP 2yCA. Conclusions: Our results indicate that the Small Step program contributed to the children's motor development, with better results for those with an initial higher HINE (>25). The specificity of training could not be confirmed.

PMID: [39274500](#)

8. Physical performance and technical specific skills of women football players with cerebral palsy

Matías Henríquez, María Isabel Cornejo, Carlos Albaladejo-García, Charlotte Messiaen, Alba Roldan, Javier Yanci, Raul Reina

Sci Rep. 2024 Sep 6;14(1):20831. doi: 10.1038/s41598-024-71967-2.

This study aimed to determine the physical performance profile (ability to change direction, vertical and horizontal jump, sprint ability, and dribbling-specific skills) of the first women football players with cerebral palsy (CP) who participated in an international CP football competition, accounting for their sport classes. We also examined the relationships between the different physical performance variables. Forty-five female players with CP (24.9 ± 7.5 years) were categorised into three sport classes based on their impairment severity: 19 were FT1 (severe impairments); 21 FT2; and 5 FT3 (mild impairments). Various physical performance tests were conducted, including the 505 change of direction test; vertical and horizontal jumps; 10 m sprint test; and the dribbling speed test. Significant correlations were observed between the change of direction ability, sprint ($r = 0.89$; $p < 0.01$), and dribbling tests ($r = 0.71$; $p < 0.01$), as well as between horizontal jump and sprint time ($r = -0.74$; $p < 0.01$). FT1 players demonstrated poorer performance compared to FT3 in the 505 test and standing broad jump ($p < 0.05$; $dg = -1.79$ and 1.22 respectively), but also lower vertical jump heights ($p < 0.05$; $dg = -0.91$ to -1.57) and increased time required for sprint ($p < 0.05$; $dg = 0.88$ to 1.16) and dribbling tests ($p < 0.05$; $dg = 0.85$ to 1.44) compared to both FT2 and FT3 players. These findings offer valuable insights into the physical performance characteristics of female footballers with CP, which can guide training and sport enhancement programs for this unique para-sport population.

PMID: [39251832](#)

9. Co-Construction of a Dance Class Adapted for Adolescents with Cerebral Palsy

Frédérique Poncet, Claire Cheriére, Lucie Beaudry, Sylvie Fortin, Martin Lemay

Phys Occup Ther Pediatr. 2024 Sep 12:1-21. doi: 10.1080/01942638.2024.2400623. Online ahead of print.

Aim: To co-construct a dance class adapted for adolescents with cerebral palsy (CP). Method: A three phase co-construction process with study collaborators was used to (1) define the objectives and the obstacles and opportunities related to offering a dance class in the community through three focus groups with adolescents, their parents and study partners; (2) co-create the dance class based on the results of step 1, the expertise of the research team and the logic model of the dance class; and (3) test the dance class to evaluate its effects in relation to the defined objectives. Results: Three objectives were identified: to have fun, promote movement, and social interaction. A weekly dance class (60 min./10 wk) was continuously tested on the adolescents and adapted by the dance facilitators. Conclusion: To improve practices and support the implementation of dance classes for young people with CP, eight recommendations are proposed relating to the creation of adapted classes and the evaluation of their desired effects.

PMID: [39262227](#)

10. Subjective measurement of physical activity and sedentary behaviour in children and adolescents with cerebral palsy: a scoping review

Mette Johansen, Britt Laugesen, Katarina Lauruschkus, Helle M Rasmussen

Disabil Rehabil. 2024 Sep 12:1-15. doi: 10.1080/09638288.2024.2400606. Online ahead of print.

Purpose: Physical activity is essential for maintaining overall health. Cost-effective and easily administered outcome instruments are valuable for clinical practice and large-scale population studies. The scoping review aimed to identify and map subjective instruments developed or validated to measure habitual physical activity and/or sedentary behaviour in children and adolescents with cerebral palsy aged 0-18 years across all levels of the GMFCS-E&R. Materials and methods: This scoping review was conducted in accordance with the JBI methodology for scoping reviews and searched the databases PubMed,

CINAHL, Web of Science, Cochrane Database of Systematic Reviews, JBI Database of Systematic Reviews and Implementation Reports, Embase and Pedro to identify articles. Results: From 288 full-text references, 13 studies met the inclusion criteria. Nine instruments measured habitual physical activity and/or sedentary behaviour in children and adolescents with cerebral palsy aged 18 months to 18 years. Six subjective instruments were tested for ambulatory children, while three instruments were tested in children and adolescents at GMFCS-E&R level I-V. Conclusion and implications: Reporting of the psychometric properties were found on reliability in three instruments, while data on validity were reported in all instruments. Further studies assessing the psychometric properties of subjective instruments in the target population are needed.

PMID: [39263845](#)

11. Acupuncture and Acupoints for Managing Pediatric Cerebral Palsy: A Meta-Analysis of Randomized Controlled Trials

Ya-Yun Cheng, Ying-Yu Huang, Tsung-Hsien Yang, Yi-Jung Chang, Ren-Huei Fu, Hsing-Yu Chen

Review Healthcare (Basel). 2024 Sep 5;12(17):1780. doi: 10.3390/healthcare12171780.

Background: Acupuncture is frequently used to manage pediatric cerebral palsy (CP), yet updated evidence is needed to guide future research and clinical practice. Methods: Seven databases were searched from 1994 to 26 June 2023. Randomized controlled trials (RCTs) involving body, scalp, or ear acupuncture for managing CP, excluding acupoint injection, catgut embedding, electro-acupuncture, or laser acupuncture, were included. Results: Twenty RCTs with 1797 participants were analyzed. Acupuncture groups had better improvements in gross motor function measure (GMFM) scores by 5% (mean difference: 5.93, 95% CI: 3.67-8.19, $p < 0.001$, $I^2 = 57%$); a 16% higher probability to yield prominent improvement in effectiveness rate (ER) (risk ratio: 1.16, 95% CI: 1.08-1.25, $p < 0.001$, $I^2 = 0%$); and better outcomes in the Modified Ashworth Scale (MAS) (standardized mean difference [SMD]: 0.3, 95% CI: 0.11-0.49, $p < 0.001$, $I^2 = 0%$), the Berg Balance Scale (BBS) (SMD: 2.48; 95% CI: 2.00-2.97, $p < 0.001$, $I^2 = 72%$) and ADL (SMD: 1.66; 95% CI: 1.23-2.08, $p < 0.001$, $I^2 = 91%$). Studies with eight core acupoints identified from all ninety-five acupoints had better ER. Conclusions: Acupuncture, especially using core acupoints, may be effective for managing symptoms in children with CP.

PMID: [39273805](#)

12. The Best Start Trial: A randomised controlled trial of ultra-early parent-administered physiotherapy for infants at high risk of cerebral palsy or motor delay

Barbara R Lucas, Jenny Bowen, Catherine Morgan, Iona Novak, Nadia Badawi, Elizabeth Elliott, Genevieve Dwyer, Venkatesha Venkatesha, Lisa A Harvey

Early Hum Dev. 2024 Sep 2;198:106111. doi: 10.1016/j.earlhumdev.2024.106111. Online ahead of print.

Background: It is unknown whether ultra-early physiotherapy commenced during neonatal intensive care unit admission is of value for optimising developmental outcomes in preterm/term infants at high-risk of cerebral palsy or motor-delay. Aims: To determine whether ultra-early parent-administered physiotherapy to preterm/term high-risk infants commenced at earliest from 34-weeks post menstrual age, improves motor outcomes at 16-weeks corrected age (CA) compared to usual care. Methods: Single-blind randomised controlled pilot study with 30 infant participants. The primary outcome was the Alberta Infant Motor Scale (AIMS) total score at 16-weeks CA. Secondary outcomes included (i) parent Depression Anxiety and Stress Score and Parent Perceptions Survey at 16-weeks CA; and (ii) Bayley Scales of Infant Development at 12-months CA. Results: There were no clinically worthwhile effects at 16-weeks CA on the AIMS (mean between-group difference, 95% CI: -0.2, -2.4 to 2.0) or most secondary outcomes. However, the parents' "perception of treatment effectiveness" and "perception of change" favoured the experimental group. Conclusions: In this pilot trial, there was no clinically worthwhile effect of ultra-early parent-administered physiotherapy over usual care on the AIMS. However, the intervention was feasible for infants, acceptable to parents and parents perceived a benefit of treatment. Whilst this trial did not demonstrate treatment effectiveness using the AIMS, these findings should be interpreted cautiously because of the small sample size, the low responsiveness of the AIMS to change in motor performance and the heterogeneity of the participants. Therefore, the intervention should not be abandoned on the basis of this trial, but rather further evaluated in a larger trial that addresses some of the learnings from this one.

PMID: [39244966](#)

13. Building independence in self-care and household tasks: a qualitative study with adolescents with cerebral palsy and their caregivers

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Disabil Rehabil. 2024 Sep 10:1-8. doi: 10.1080/09638288.2024.2401142. Online ahead of print.

Purpose: Adolescents with cerebral palsy (CP) may experience limitations in self-care and household tasks. The aim of the study was to understand the process of building independence in self-care and household tasks from the perspective of adolescents and their caregivers. **Materials and methods:** We conducted a qualitative study with a phenomenological approach with 10 adolescents (15-17 years old) and 11 caregivers from a transition service in Brazil. Semistructured, remote interviews were conducted with each participant. The interviews were recorded for transcription and content analysis. **Results:** Two thematic categories emerged: (1) "Thinking about independence" and (2) "Possible ways to foster independence." The first category was divided into three subcategories: "Expectations and the desire to be independent," "Obstacles to independence," "Concerns about the future." The second category was divided into four subcategories: "People and places," "Opportunities for practice," "Personal attitude" and "Adaptations that facilitate." **Conclusion:** Adolescents' independence in several everyday activities involves physical, socioemotional and environmental aspects. Enabling opportunities for practice, an adapted environment, support from rehabilitation services and developing collaborative relationships with caregivers are elements that may favor the independence of adolescents with CP.

PMID: [39254491](#)

14. Factors associated with poor sleep in children with drug-resistant epilepsy

Renee Proost, Evy Cleeren, Bastiaan Jansen, Lieven Lagae, Wim Van Paesschen, Katrien Jansen

Epilepsia. 2024 Sep 10. doi: 10.1111/epi.18112. Online ahead of print.

Objective: We aimed to investigate sleep in children with drug-resistant epilepsy (DRE), including developmental and epileptic encephalopathies (DEEs). Next, we examined differences in sleep macrostructure and microstructure and questionnaire outcomes between children with well-controlled epilepsy (WCE) and children with DRE. Furthermore, we wanted to identify factors associated with poor sleep outcome in these children, as some factors might be targets to improve epilepsy and neurodevelopmental outcomes. **Methods:** A cross-sectional study was conducted in children 4 to 18-years-old. Children without epilepsy, with WCE, and with DRE were included. Overnight electroencephalography (EEG), including chin electromyography and electrooculography, to allow sleep staging, was performed. Parents were asked to fill out a sleep questionnaire. Classical five-stage sleep scoring was performed manually, spindles were automatically counted, and slow wave activity (SWA) in the first and last hour of slow wave sleep was calculated. **Results:** One hundred eighty-two patients were included: 48 without epilepsy, 75 with WCE, and 59 with DRE. We found that children with DRE have significantly lower sleep efficiency (SE%), less time spent in rapid eye movement (REM) sleep, fewer sleep spindles, and a lower SWA decline over the night compared to children with WCE. Subjectively more severe sleep problems were reported by the caregivers and more daytime sleepiness was present in children with DRE. Least absolute shrinkage and selection operator (LASSO) regression showed that multifocal interictal epileptiform discharges (IEDs), benzodiazepine treatment, and longer duration of epilepsy were associated with lower SE% and lower REM sleep time. The presence of multifocal discharges and cerebral palsy was associated with fewer spindles. Benzodiazepine treatment, drug resistance, seizures during sleep, intellectual disability, and older age were associated with lower SWA decline. **Significance:** Both sleep macrostructure and microstructure are severely impacted in children with DRE, including those with DEEs. Epilepsy parameters play a distinct role in the disruption REM sleep, spindle count, and SWA decline.

PMID: [39254374](#)

15. Transferability of an executive function intervention in children with cerebral palsy: A randomized controlled trial

Montse Blasco, María García-Galant, Júlia Ballester-Plané, Olga Laporta-Hoyos, Xavier Caldú, David Leiva, Roslyn N Boyd, Els Ortibus, Roser Pueyo; Clinic Practice Group

Dev Med Child Neurol. 2024 Sep 11. doi: 10.1111/dmcn.16057. Online ahead of print.

Aim: To evaluate the transfer effects of a home-based computerized executive function intervention on non-targeted cognitive functions (visual perception and memory), quality of life (QoL), and participation in children with cerebral palsy (CP), and to determine whether any improvements were maintained 9 months after the intervention. **Method:** Sixty children with CP (aged 8-12 years) were randomly allocated to the intervention (15 females/15 males, mean age 10 years 4 months [SD = 1 years 8 months], age range 8-12 years) or waitlist (control) (15 females/15 males, mean age 10 years [SD = 1 years 9 months], age range 8-12 years) group. The intervention group underwent a home-based executive function intervention programme for 30 minutes per day, 5 days a week, for 12 weeks. All participants were assessed before the intervention, immediately after and 9 months after the intervention was completed. **Results:** After the intervention was completed, performance in immediate verbal memory, verbal learning, and visual perception (object and picture recognition) was significantly better in the intervention group than in the waitlist (control) group. No improvements were found in visual memory, visuospatial perception, QoL, or participation after the intervention. Scores at the follow-up showed that any beneficial effects were not maintained 9 months after the intervention was completed. **Interpretation:** A home-based computerized executive function intervention produced transfer effects on memory and visual perception immediately after the intervention in children with CP, although any beneficial effects were not sustained at the 9-month follow-up.

PMID: [39258948](#)

16. Chronic Facial Pain in an Adolescent

Jamie W Lewis, Trace T Palmer, Jeffrey D Carron

JAMA Otolaryngol Head Neck Surg. 2024 Sep 12. doi: 10.1001/jamaoto.2024.2689. Online ahead of print.

No abstract available

PMID: [39264639](#)

17. Exploring the quantity and quality of symptoms of attention deficit hyperactivity disorder and intelligence in children with cerebral palsy: a case-control study

Zerrin Kasap, Cansu Çobanoğlu Osmanlı, İlker Fatih Sarı, Evren Er, Berkan Şahin, Fazıl Kulaklı

Eur J Pediatr. 2024 Sep 12. doi: 10.1007/s00431-024-05740-y. Online ahead of print.

To evaluate whether attention deficit hyperactivity disorder (ADHD) symptoms differ across cerebral palsy (CP) and the relationship of these symptoms to CP disease data. Each of the three groups (CP, ADHD, and control) included 22 volunteers, aged 6-18. The CP group was divided into two groups, with and without ADHD (CP + ADHD and CP-ADHD). The groups were compared in terms of clinical data, ADHD symptoms, and intelligence levels. ADHD was reported in 36.4% of the CP group and 9.1% of the control group ($p = 0.031$). The rate of moderate/severe motor disability was higher ($p = 0.052$), and the Wechsler Intelligence Scale for Children-Revised (WISC-R) (total, performance, verbal) scores were lower in the CP + ADHD group compared to the CP-ADHD group ($p = 0.005$, $p = 0.005$, $p = 0.002$). Cognitive problems/inattention scores were higher in the CP group compared to the control group ($p = 0.015$). WISC-R (total, performance, verbal) scores were lower in the CP group compared to the ADHD group ($p = 0.008$, $p = 0.001$, $p = 0.047$) and the control group ($p < 0.001$, $p < 0.001$, $p = 0.001$). Conclusion: ADHD is more common in CP and may be seen in a predominantly inattentive presentation. It is related to a worse motor disability and intelligence level in CP. What is known: Compared to the general population, ADHD is reported to be more common in children with CP. What is new: ADHD may be seen in a predominantly inattentive presentation rather than the other presentations in children with CP. ADHD is related to a worse motor disability and intelligence level in CP.

PMID: [39264468](#)

18. The Use of TheraBracelet Upper Extremity Vibrotactile Stimulation in a Child with Cerebral Palsy-A Case Report

Na Jin Seo, Molly Brinkhoff, Savannah Fredendall, Patricia Coker-Bolt, Kelly McGloon, Elizabeth Humanitzki

Electronics (Basel). 2024 Aug 2;13(16):3147. doi: 10.3390/electronics13163147. Epub 2024 Aug 9.

Background: TheraBracelet is peripheral vibrotactile stimulation applied to the affected upper extremity via a wristwatch-like wearable device during daily activities and therapy to improve upper limb function. The objective of this study was to examine feasibility of using TheraBracelet for a child with hemiplegic cerebral palsy. Methods: A nine-year-old male with cerebral palsy was provided with TheraBracelet to use during daily activities in the home and community settings for 1.5 years while receiving standard care physical/occupational therapy. Results: The child used TheraBracelet independently and consistently except during summer vacations and elbow-to-wrist orthotic use from growth spurt-related contracture. The use of TheraBracelet did not impede or prevent participation in daily activities. No study-related adverse events were reported by the therapist, child, or parent. Conclusion: Future research is warranted to investigate TheraBracelet as a propitious therapeutic device with focus on potential impact of use to improve the affected upper limb function in daily activities in children with hemiplegic cerebral palsy.

PMID: [39267797](#)

19. Simulating space walking: a systematic review on anti-gravity technology in neurorehabilitation

Bonanno M, Maggio Mg, Quartarone A, De Nunzio Am, Calabrò Rs

Review J Neuroeng Rehabil. 2024 Sep 13;21(1):159. doi: 10.1186/s12984-024-01449-z.

Neurological disorders, such as Parkinson's disease (PD), multiple sclerosis (MS), cerebral palsy (CP) and stroke are well-known causes of gait and balance alterations. Innovative devices (i.e., robotics) are often used to promote motor recovery. As an alternative, anti-gravity treadmills, which were developed by NASA, allow early mobilization, walking with less effort to reduce gait energy costs and fatigue. A systematic search, according to PRISMA guidelines, was conducted for all peer-

reviewed articles published from January 2010 through September 2023, using the following databases: PubMed, Scopus, PEDro and IEEE Xplore. After an accurate screening, we selected only 16 articles (e.g., 5 RCTs, 2 clinical trials, 7 pilot studies, 1 prospective study and 1 exploratory study). The evidence collected in this systematic review reported promising results in the field of anti-gravity technology for neurological patients, in terms of improvement in gait and balance outcomes. However, we are not able to provide any clinical recommendation about the dose and parameters of anti-gravity treadmill training, because of the lack of robust high-quality RCT studies and large samples. Registration number CRD42023459665.

PMID: [39272129](#)

20. Pharmacological Strategies and Surgical Management of Posthemorrhagic Hydrocephalus Following Germinal Matrix-Intraventricular Hemorrhage in Preterm Infants

Zhao Yang, Tian Tian Luo, Ya-Lan Dai, Han-Xiao Duan, Cheong-Meng Chong, Jun Tang

Curr Neuropharmacol. 2024 Sep 6. doi: 10.2174/1570159X23666240906115817. Online ahead of print.

Germinal matrix-intraventricular hemorrhage (GM-IVH) is a detrimental neurological complication that occurs in preterm infants, especially in babies born before 32 weeks of gestation and in those with a very low birth weight. GM-IVH is defined as a rupture of the immature and fragile capillaries located in the subependymal germinal matrix zone of the preterm infant brain, and it can lead to detrimental neurological sequelae such as posthemorrhagic hydrocephalus (PHH), cerebral palsy, and other cognitive impairments. PHH following GM-IVH is difficult to treat in the clinic, and no levelone strategies have been recommended to pediatric neurosurgeons. Several cellular and molecular mechanisms of PHH following GM-IVH have been studied in animal models, but no effective pharmacological strategies have been used in the clinic. Thus, a comprehensive understanding of molecular mechanisms, potential pharmacological strategies, and surgical management of PHH is urgently needed. The present review presents a synopsis of the pathogenesis, diagnosis, and cellular and molecular mechanisms of PHH following GM-IVH and explores pharmacological strategies and surgical management.

PMID: [39248058](#)

21. Presumed Perinatal Ischemic Left Middle Cerebral Artery Stroke With Cerebral Palsy, Developmental Delay, and Epilepsy: A Case Report

Harneet S Randhawa, Jasneet Randhawa, Karanvir S Aulakh, Akshay More, Akshay Jain

Case Reports Cureus. 2024 Aug 6;16(8):e66337. doi: 10.7759/cureus.66337. eCollection 2024 Aug.

The perinatal period is a high risk for ischemic events to occur leading to lifelong morbidity. Various patterns of ischemic injury to the fetal and neonatal brain have been studied depending on gestational age as well as the degree of hypoxia/ischemia. We present a case of presumed perinatal ischemic left middle cerebral artery stroke diagnosed by magnetic resonance imaging (MRI) in a child with global developmental delay, cerebral palsy, and epilepsy. Interestingly, the typical features of middle cerebral artery stroke are often not present in perinatal strokes, and hence these are not imaged perinatally. Since studies and research into neuroplasticity and neuromodulation are current topics of interest and several research studies are being conducted, we wish to add this case to the available scientific literature.

PMID: [39246998](#)

22. Clinically Relevant Genes Identified in Cerebral Palsy Cohorts Following Evaluation of the Clinical Description and Phenotype: A Systematic Review

Yana A Wilson, Natasha Garrity, Hayley Smithers-Sheedy, Shona Goldsmith, Tasneem Karim, Georgina Henry, Simon Paget, Maria Kyriagis, Nadia Badawi, Gareth Baynam, Jozef Gecz, Sarah McIntyre

Review J Child Neurol. 2024 Sep 9;8830738241277231. doi: 10.1177/08830738241277231. Online ahead of print.

A growing number of genes have been identified in individuals with cerebral palsy (CP); however, many of these studies have poor compliance with the cerebral palsy clinical description. This systematic review aimed to assess the quality of the cerebral palsy clinical description/phenotype in cerebral palsy genetic studies published between 2010 and 2024 and report clinically relevant genes based on the quality of the cerebral palsy phenotype. An expert panel developed 6 criteria to review the reported cerebral palsy phenotype/description for each included study. Clinically relevant genes were extracted from each study and stratified into 2 tiers based on the quality. Eighteen studies were included. There was high confidence in the reported cerebral palsy description/phenotype from 8 studies. Of the initial 373 clinically relevant genes, 85 were tier II genes. Individual cerebral palsy motor disorder and phenotype data were absent for 349 of these individuals, limiting further analysis. The tier I gene list was composed of 6 genes: ATL1, COL4A1, GNAO1, KIF1A, SPAST, and TUBA1A. Bilateral spasticity was the most common motor disorder reported in individuals with variants in all 6 genes, and most individuals had accompanying

conditions. Prioritizing the accurate reporting of motor and nonmotor phenotypes is crucial for future cerebral palsy genetic studies to further understand the underlying neurobiology.

PMID: [39246294](#)

23. Gender-specific association of multiple risk factors with neonatal moderate or severe hypoxic ischemic encephalopathy: a cross-sectional study

Yiran Wang, Yaodong Zhang, Shuying Luo, Kaijuan Wang

Ital J Pediatr. 2024 Sep 9;50(1):169. doi: 10.1186/s13052-024-01748-0.

Background: Neonatal hypoxic ischemic encephalopathy (HIE) leads to different degrees of neurological sequelae. The incidence of HIE is relatively high, and the causal pathways leading to HIE are still controversial. This study aimed to investigate the risk factors associated with HIE comparing differences between genders. **Methods:** A cross-sectional study of 196 neonates diagnosed with HIE was conducted. Based on the severity of clinical findings, HIE was classified as mild, moderate or severe. For mild HIE, the outcomes were relatively less severe, whereas moderate to severe HIE could suffer serious consequences, including death, cerebral palsy, epilepsy. T-test, chi-square test and logistic regression were used to analyze data. **Results:** Among the 196 neonatal HIE, 39 (19.9%) had mild HIE, 157 (80.1%) had moderate or severe HIE. The logistic regression analysis showed that gender was a specific stratified characteristic of moderate or severe HIE. In the male neonates group, emergency cesarean section, abnormal labor stage and amniotic fluid contamination were associated with an increased risk of moderate or severe HIE, where the adjusted odds ratios (ORs) were 4.378 (95% confidence intervals (CI):2.263-6.382), 2.827 (95% CI:1.743-5.196) and 2.653 (95%CI:1.645-3.972), respectively. As expected, a significant additive effect was found in the interactions between emergency cesarean section and abnormal labor stage, as well as between emergency cesarean section and amniotic fluid contamination, where the relative excess risk of interaction was 2.315(95% CI:1.573-3.652) and 1.896(95%CI: 1.337-3.861) respectively. **Conclusion:** Emergency cesarean section, abnormal labor stage and amniotic fluid contamination were risk factors of moderate or severe HIE in neonates, and the associations were significantly correlated with male gender. Notably, coinciding incidences of emergency cesarean section with abnormal labor stage, or emergency cesarean section with amniotic fluid contamination were possibly synergistic in increasing the risk of moderate or severe HIE. These findings may assist clinicians in strengthening their awareness on risks affecting HIE and help reduce the incidence of moderate or severe HIE in clinical practice.

PMID: [39245710](#)

24. Development and validation of prediction models for fetal growth restriction and birthweight: an individual participant data meta-analysis

John Allotey, Lucinda Archer, Dyuti Coomar, Kym Ie Snell, Melanie Smuk, Lucy Oakey, Sadia Haqnawaz, Ana Pilar Betrán, Lucy C Chappell, Wessel Ganzevoort, Sanne Gordijn, Asma Khalil, Ben W Mol, Rachel K Morris, Jenny Myers, Aris T Papageorgiou, Basky Thilaganathan, Fabricio Da Silva Costa, Fabio Facchinetti, Arri Coomarasamy, Akihide Ohkuchi, Anne Eskild, Javier Arenas Ramirez, Alberto Galindo, Ignacio Herraiz, Federico Prefumo, Shigeru Saito, Line Sletner, Jose Guilherme Cecatti, Rinat Gabbay-Benziv, Francois Goffinet, Ahmet A Baschat, Renato T Souza, Fionnuala Mone, Diane Farrar, Seppo Heinonen, Kjell Å Salvesen, Luc Jm Smits, Sohinee Bhattacharya , Chie Nagata, Satoru Takeda, Marleen Mh van Gelder, Dewi Anggraini, SeonAe Yeo, Jane West, Javier Zamora, Hema Mistry, Richard D Riley, Shakila Thangaratnam

Meta-Analysis Health Technol Assess. 2024 Aug;28(47):1-119. doi: 10.3310/DABW4814.

Background: Fetal growth restriction is associated with perinatal morbidity and mortality. Early identification of women having at-risk fetuses can reduce perinatal adverse outcomes. **Objectives:** To assess the predictive performance of existing models predicting fetal growth restriction and birthweight, and if needed, to develop and validate new multivariable models using individual participant data. **Design:** Individual participant data meta-analyses of cohorts in International Prediction of Pregnancy Complications network, decision curve analysis and health economics analysis. **Participants:** Pregnant women at booking. **External validation of existing models** (9 cohorts, 441,415 pregnancies); **International Prediction of Pregnancy Complications model development and validation** (4 cohorts, 237,228 pregnancies). **Predictors:** Maternal clinical characteristics, biochemical and ultrasound markers. **Primary outcomes:** fetal growth restriction defined as birthweight <10th centile adjusted for gestational age and with stillbirth, neonatal death or delivery before 32 weeks' gestation birthweight. **Analysis:** First, we externally validated existing models using individual participant data meta-analysis. If needed, we developed and validated new International Prediction of Pregnancy Complications models using random-intercept regression models with backward elimination for variable selection and undertook internal-external cross-validation. We estimated the study-specific performance (c-statistic, calibration slope, calibration-in-the-large) for each model and pooled using random-effects meta-analysis. Heterogeneity was quantified using τ^2 and 95% prediction intervals. We assessed the clinical utility of the fetal growth restriction model using decision curve analysis, and health economics analysis based on National Institute for Health and Care Excellence 2008 model. **Results:** Of the 119 published models, one birthweight model (Poon) could be validated. None reported fetal growth restriction using our definition. Across all cohorts, the Poon model had good summary calibration slope of 0.93 (95% confidence interval 0.90 to 0.96) with slight overfitting, and underpredicted birthweight by 90.4

g on average (95% confidence interval 37.9 g to 142.9 g). The newly developed International Prediction of Pregnancy Complications-fetal growth restriction model included maternal age, height, parity, smoking status, ethnicity, and any history of hypertension, pre-eclampsia, previous stillbirth or small for gestational age baby and gestational age at delivery. This allowed predictions conditional on a range of assumed gestational ages at delivery. The pooled apparent c-statistic and calibration were 0.96 (95% confidence interval 0.51 to 1.0), and 0.95 (95% confidence interval 0.67 to 1.23), respectively. The model showed positive net benefit for predicted probability thresholds between 1% and 90%. In addition to the predictors in the International Prediction of Pregnancy Complications-fetal growth restriction model, the International Prediction of Pregnancy Complications-birthweight model included maternal weight, history of diabetes and mode of conception. Average calibration slope across cohorts in the internal-external cross-validation was 1.00 (95% confidence interval 0.78 to 1.23) with no evidence of overfitting. Birthweight was underestimated by 9.7 g on average (95% confidence interval -154.3 g to 173.8 g). Limitations: We could not externally validate most of the published models due to variations in the definitions of outcomes. Internal-external cross-validation of our International Prediction of Pregnancy Complications-fetal growth restriction model was limited by the paucity of events in the included cohorts. The economic evaluation using the published National Institute for Health and Care Excellence 2008 model may not reflect current practice, and full economic evaluation was not possible due to paucity of data. Future work: International Prediction of Pregnancy Complications models' performance needs to be assessed in routine practice, and their impact on decision-making and clinical outcomes needs evaluation. Conclusion: The International Prediction of Pregnancy Complications-fetal growth restriction and International Prediction of Pregnancy Complications-birthweight models accurately predict fetal growth restriction and birthweight for various assumed gestational ages at delivery. These can be used to stratify the risk status at booking, plan monitoring and management. Study registration: This study is registered as PROSPERO CRD42019135045. Funding: This award was funded by the National Institute for Health and Care Research (NIHR) Health Technology Assessment programme (NIHR award ref: 17/148/07) and is published in full in Health Technology Assessment; Vol. 28, No. 14. See the NIHR Funding and Awards website for further award information.

PMID: [39252507](#)

25. Tractography of sensorimotor pathways in dyskinetic cerebral palsy: Association with motor function

Xavier Caldú, Lee B Reid, Kerstin Pannek, Jurgen Fripp, Júlia Ballester-Plané, David Leiva, Roslyn N Boyd, Roser Pueyo, Olga Laporta-Hoyos

Ann Clin Transl Neurol. 2024 Sep 10. doi: 10.1002/acn3.52174. Online ahead of print.

Objectives: Neuroimaging studies of dyskinetic cerebral palsy (CP) are scarce and the neuropathological underpinnings are not fully understood. We delineated the corticospinal tract (CST) and cortico-striatal-thalamocortical (CSTC) pathways with probabilistic tractography to assess their (1) integrity and (2) association with motor functioning in people with dyskinetic CP. Methods: Diffusion weighted magnetic resonance images were obtained for 33 individuals with dyskinetic CP and 33 controls. Fractional anisotropy (FA) and mean diffusivity (MD) for the CST and the CSTC pathways were compared between groups. Correlation analyses were performed between tensor metric values and motor function scores of participants with dyskinetic CP as assessed by the Gross Motor Function Classification System (GMFCS), the Bimanual Fine Motor Function (BFMF), and the Manual Ability Classification System (MACS). Results: White matter integrity in both the CST and the CSTC pathways was reduced in people with dyskinetic CP. The GMFCS, MACS and, less commonly, the BFMF were associated with FA and, particularly, MD in most portions of these pathways. Interpretation: The present study advances our understanding of the involvement of white matter microstructure in sensorimotor pathways and its relationship with motor impairment in people with dyskinetic CP. Our results are consistent with well-described relationships between upper limb function and white matter integrity in the CST and CSTC pathways in other forms of CP. This knowledge may ultimately help prognosis and therapeutic programmes.

PMID: [39257055](#)

26. Needs for rehabilitation in China: Estimates based on the Global Burden of Disease Study 1990-2019

Tian Tian, Lin Zhu, Qingzhen Fu, Shiheng Tan, Yukun Cao, Ding Zhang, Mingxue Wang, Ting Zheng, Lijing Gao, Daria Volontovich, Yongchen Wang, Jinming Zhang, Zhimei Jiang, Hongbin Qiu, Fan Wang, Yashuang Zhao

Chin Med J (Engl). 2024 Sep 11. doi: 10.1097/CM9.0000000000003245. Online ahead of print.

Background: As an essential part of health services, rehabilitation is of great significance to improve the health and quality of life of the whole population. Accelerating aging calls for a significant expansion of rehabilitation services in China, but rehabilitation needs remain unclear. We conducted the study to explore the rehabilitation needs in China and project the trend of rehabilitation needs from 2020 to 2034. Methods: The data of health conditions that might potentially benefit from rehabilitation were obtained from Global Burden of Disease (GBD) study. Estimated annual percentage changes (EAPCs) were calculated to quantify the trends of the age-standardized rates. Projections of rehabilitation needs were made until 2034 using Bayesian age-period-cohort analysis (BAPC). Results: Approximately 460 million persons (33.3% of the total population) need rehabilitation in China, contributing to 63 million years lived with disabilities (YLDs) in 2019. The number of prevalent cases increased from around 268 (95% uncertainty interval [UI]: 257-282) million in 1990 to almost 460 (95% UI: 443-479) million

in 2019, representing an increase of 71.3%. The highest contribution to the need for rehabilitation was musculoskeletal disorders with about 322 (95% UI: 302-343) million persons in seven aggregate disease and injury categories, and hearing loss with over 95 (95% UI: 84-107) million people among 25 health conditions. Based on the projection results, there will be almost 636 million people (45% of the total population) needing rehabilitation services in China by 2034, representing an increase of 38.3%. The rehabilitation needs of neoplasms, cardiovascular diseases, and neurological disorders are expected to increase significantly from 2019 to 2034, with increases of 102.3%, 88.8% and 73.2%, respectively. Conclusions: The need for rehabilitation in China substantially increased over the last 30 years. It is predicted that over two in five people will require rehabilitation by 2034, thus suggesting the need to develop rehabilitation services that meet individuals' rehabilitation needs.

PMID: [39258433](#)

27. Reliability and Construct Validity of the Japanese Version of the Posture and Postural Ability Scale in Individuals with Cerebral Palsy

Yuki Kimura, Yasuaki Kusumoto, Hiroto Hayashi, Natsui Kyuji, Akiho Nasu, Hirotaka Gima

Phys Ther Res. 2024;27(2):92-99. doi: 10.1298/ptr.E10287. Epub 2024 May 29.

Objective: This study aimed to develop the Japanese version of the Posture and Postural Ability Scale (PPAS) and verify its inter- and intra-rater reliability, construct validity, and internal consistency in individuals with cerebral palsy (CP) in Japan. **Methods:** This cross-sectional study recruited 73 children and adults with CP at all Gross Motor Function Classification System (GMFCS) levels. The translation procedure was performed by three Japanese physiotherapists and the developer of the original version. Intra- and inter-rater reliability were evaluated using the weighted kappa coefficients, and construct validity was based on the correlation coefficients between PPAS and GMFCS. Cronbach's alpha coefficients were calculated to assess internal consistency. **Results:** Weighted kappa coefficients for intra- and inter-rater reliability exceeded 0.81 for all items. The correlation coefficients between the PPAS and GMFCS were negative and showed "moderate" to "very strong" in almost all items ($\rho = -0.66$ to -0.91), except for one item ($\rho = -0.37$). Cronbach's alpha coefficients exceeded 0.80 in all four positions. **Conclusion:** This study supports the Japanese version of the PPAS with excellent intra- and inter-rater reliability, good construct validity, and internal consistency in the Japanese CP population.

PMID: [39257521](#)

28. Developmental screening of neurodevelopmental disorders before age 6: a nationwide health screening program

Jong Ho Cha, Soorack Ryu, Minjung Park, Byung Chan Lim, Yong Joo Kim, Jin-Hwa Moon

Pediatr Res. 2024 Sep 11. doi: 10.1038/s41390-024-03516-6. Online ahead of print.

Background: We aimed to investigate the association between developmental screening before 24 months of age and neurodevelopmental disorders (NDDs) at 4-6 years of age. **Methods:** We included 922,899 newborn born between 2014 and 2016 registered in National Health Insurance Service (NHIS). Developmental screening was administered at 9-12 and 18-24 months old with the Korean Developmental Screening Test for Infants & Children (K-DST). Diagnoses of NDDs was based on the World Health Organization's International Classification of Diseases, Tenth Revision (ICD-10), provided by the NHIS database. **Results:** Among 637,277 individuals who underwent screening at 9-12 and 18-24 months, Screen-positivity (defined as summed score < -2 standard deviation) for gross motor domain at 9-12 months was significantly associated with the incidence of autism spectrum disorder (aHR, 2.24; 95% CI, 1.80-2.80) and cerebral palsy (aHR, 4.81; 95% CI, 3.62-6.38). Screening positive at language domain at 18-24 months old was associated with autism spectrum disorder (aHR 5.50; 95% CI, 4.31- 7.02) and developmental language disorder (aHR 8.67; 95% CI, 7.27-10.33) at 4-6 years of age. **Conclusion:** Widespread nationwide implementation of screening programs before 24 months was effective in identifying NDDs at 4-6 years of age. Further strategies integrating with referral and intervention systems should be established. **Impact:** We investigated the screening effect of nationwide developmental screening program on neurodevelopmental disorders using nationwide data. Gross motor delay during infancy was significant predictor of later neurodevelopmental disorders. Language, cognitive, and social delay before 24 months of age was associated with later autism spectrum disorders and developmental language disorders. Widespread nationwide implementation of screening programs before 24 months was effective in identifying NDDs at 4-6 years of age and should be encouraged.

PMID: [39261660](#)

29. Evidence-Based Infant Assessment for Cerebral Palsy: Diagnosis Timelines and Intervention Access in a Newborn Follow-up Setting

Ellen N Sutter, Janet M Legare, Melissa A Villegas, Kellie M Collins, Jens Eickhoff, Bernadette T Gillick

J Child Neurol. 2024 Sep 12:8830738241279690. doi: 10.1177/08830738241279690. Online ahead of print.

Evidence-based assessment pathways inform early detection of cerebral palsy and access to intervention. This study investigated the relationships between early evidence-based assessments, diagnosis timeline, and rehabilitation intervention access in a population of children with cerebral palsy who were seen between 2010 and 2022 at the University of Wisconsin Waisman Center Newborn Follow Up Clinic. Cerebral palsy-specific assessments were increasingly integrated after the publication of early detection guidelines by Novak et al. in 2017. Age at cerebral palsy first mention (high risk for cerebral palsy) decreased over time, although age at diagnosis remained similar. Infants who received multiple evidence-based assessments were diagnosed at a younger age. Ninety-nine percent of children were referred to rehabilitation therapies before diagnosis. Infant age at referral to outpatient therapies decreased over time. This study provides novel clinical data on diagnosis timelines and identifies remaining gaps related to implementation feasibility toward improved early diagnosis and intervention access.

PMID: [39262331](#)

30. Identification of Putative Biomarkers in Cerebral Palsy: A Meta-Analysis and Meta-Regression

Vinay Suresh, Shiva Gupta, Yashita Khulbe, Muhammad Aaqib Shamim, Vaibhav Jain, Malavika Jayan, Madeeha Subhan Waleed, Neha Joe, Vivek Sanker, Aravind P Gandhi, Areesha Alam, Hardeep Singh Malhotra, Ravindra K Garg, Sheffali Gulati, Priyanka Roy, Mainak Bardhan

Pediatr Neurol. 2024 Aug 2;161:43-54. doi: 10.1016/j.pediatrneurol.2024.07.016. Online ahead of print.

Background: Cerebral palsy (CP) is a neurological disorder that impairs motor abilities. Identifying maternal biomarker derangements can facilitate further evaluation for early diagnosis, potentially leading to improved clinical outcomes. This study investigates the association between maternal biomarker derangements and CP development during the antenatal period. **Methods:** A systematic search was conducted in MEDLINE, EMBASE, and Cochrane databases, following MOOSE guidelines. Data on participants exceeding biomarker thresholds (95th and 5th percentiles) were extracted for combined odds ratio estimation. Geometric mean differences, reported as multiples of the median (MoMs), were used to analyze changes in marker levels. Trimesterwise subgroup analysis and metaregression assessed the impact of variables on outcomes. **Results:** Five observational studies (1552 cases, 484,985 controls) revealed lower maternal pregnancy-associated plasma protein A levels were associated with CP (pooled odds ratio [OR] = 1.60, 95% confidence interval [CI] = 1.22 to 2.09; I = 0%), with a -0.04 MoM geometric mean difference. Lower maternal beta-human chorionic gonadotropin (HCG) levels in first and second trimesters indicated a pooled OR = 1.18 (95% CI = 0.85 to 1.63; I = 57%). Sensitivity analysis showed an OR = 1.40 (95% CI = 1.08 to 1.82; I = 0%), with a -0.07 MoM geometric mean difference. Metaregression identified primigravida status as negatively influencing beta-HCG levels. Elevated nuchal translucency values and CP presented a pooled OR = 1.06 (95% CI = 0.77 to 1.44; I = 0%). **Conclusion:** Lower maternal pregnancy-associated plasma protein A levels during the first trimester and lower beta-HCG levels in the first and second trimesters are associated with CP development in children. Future research should validate the predictive utility of these biomarkers and explore novel ones through large-scale cohort studies.

PMID: [39265434](#)

31. New-onset hydrocephalus in an adult with cerebral palsy: A case report and review of the literature

Jeremy Roberts, Denesh Ratnasingam, Cristina Sarmiento

J Pediatr Rehabil Med. 2024 Sep 10. doi: 10.3233/PRM-240015. Online ahead of print.

Hydrocephalus is a common comorbidity associated with brain injuries, including cerebral palsy (CP). In CP, hydrocephalus typically presents in infancy or early childhood. This report describes a patient in their mid 20s with mixed dyskinetic-spastic CP with adult-onset hydrocephalus of unknown cause initially presenting with new-onset bilateral lower extremity spasms. Multiple interventions were trialed, including ischial bursal steroid injections, botulinum toxin injections, trigger point injections, multiple oral medications, and physical and massage therapies without benefit. Given lack of treatment response, imaging of the neuraxis was obtained. Magnetic resonance imaging (MRI) of the brain demonstrated new diffuse moderate ventriculomegaly compared to prior MRI. Ophthalmologic evaluation demonstrated papilledema, and opening pressure on lumbar puncture was elevated to 44 mmHg H₂O. The patient underwent ventriculoperitoneal shunt placement with rapid and near-resolution of their spasms and pain. This patient represents a unique case of new-onset hydrocephalus in an adult with CP. To ensure appropriate and timely diagnosis and treatment, individuals with neurologic conditions such as CP should have ongoing surveillance and comprehensive evaluation for any neurologic or functional changes, including changes in baseline tone. Future research is needed to better understand if adults with CP are at higher risk for the development of hydrocephalus in adulthood.

PMID: [39269861](#)

32. Effect of non-invasive brain stimulation in children with acquired brain injury-a scoping review

Chandrasekar Rathinam, Vikram Mohan, Derick Yates, Peter Bill, Janet Peirson, Rajat Gupta

Front Neurol. 2024 Aug 29;15:1388718. doi: 10.3389/fneur.2024.1388718. eCollection 2024.

Background: Children and young people (CYP) with acquired brain injury (ABI) require early and effective neurorehabilitation to improve long-term functional outcomes. Non-invasive brain stimulation (NIBS), including transcranial magnetic stimulation (TMS) and transcranial direct current stimulation (tDCS), have been used to improve motor and sensory skills for children with cerebral palsy. However, there is limited evidence supporting its use in CYP with ABI. **Objective:** To systematically review the TMS and tDCS intervention effects on motor, sensory and other functional issues in CYP with ABI as reported in the literature. **Methods:** A comprehensive online bibliographic databases search was performed in various databases using keywords related to NIBS and CYP with ABI. Studies that examine the effect of NIBS intervention on motor function and other functional difficulties either as a primary or secondary objective were included in this review. **Results:** Fourteen studies (10 single case reports, one retrospective analysis, one case series, one randomised and one quasi-randomised controlled trial) published between 2006 and 2023 were identified. These studies examined the use of NIBS to manage motor disorders, hearing, vision, headaches, speech and language and memory issues. Seventy-six children with mild to severe ABI had received NIBS. The session frequency (3-20), duration (10-45 min) was variable, and NIBS delivered between 3 and 28 days. **Conclusion:** The literature describing NIBS interventions in CYP with ABI is scarce. An insufficient number of studies, inadequate information reported in them, and small sample sizes limit the ability to conclude how effective NIBS is in improving motor function and other functional issues in this cohort. Further studies are therefore necessary to examine the therapeutic effects of NIBS to manage various functional problems in the CYP with ABI.

PMID: [39268070](#)

33. Role of Data-driven Regional Growth Model in Shaping Brain Folding Patterns

Jixin Hou, Zhengwang Wu, Xianyan Chen, Li Wang, Dajiang Zhu, Tianming Liu, Gang Li, Xianqiao Wang

ArXiv [Preprint]. 2024 Sep 4:arXiv:2408.17334v2.

The surface morphology of the developing mammalian brain is crucial for understanding brain function and dysfunction. Computational modeling offers valuable insights into the underlying mechanisms for early brain folding. Recent findings indicate significant regional variations in brain tissue growth, while the role of these variations in cortical development remains unclear. In this study, we unprecedentedly explored how regional cortical growth affects brain folding patterns using computational simulation. We first developed growth models for typical cortical regions using machine learning (ML)-assisted symbolic regression, based on longitudinal real surface expansion and cortical thickness data from prenatal and infant brains derived from over 1,000 MRI scans of 735 pediatric subjects with ages ranging from 29 post-menstrual weeks to 24 months. These models were subsequently integrated into computational software to simulate cortical development with anatomically realistic geometric models. We comprehensively quantified the resulting folding patterns using multiple metrics such as mean curvature, sulcal depth, and gyrification index. Our results demonstrate that regional growth models generate complex brain folding patterns that more closely match actual brains structures, both quantitatively and qualitatively, compared to conventional uniform growth models. Growth magnitude plays a dominant role in shaping folding patterns, while growth trajectory has a minor influence. Moreover, multi-region models better capture the intricacies of brain folding than single-region models. Our results underscore the necessity and importance of incorporating regional growth heterogeneity into brain folding simulations, which could enhance early diagnosis and treatment of cortical malformations and neurodevelopmental disorders such as cerebral palsy and autism.

PMID: [39253642](#)

Prevention and Cure

34. Constraint-Induced Movement Therapy (CIMT) and Neural Precursor Cell (NPC) Transplantation Synergistically Promote Anatomical and Functional Recovery in a Hypoxic-Ischemic Mouse Model

Prakasham Rumajogee, Svetlana Altamentova, Junyi Li, Nirushan Puvanenthirarajah, Jian Wang, Azam Asgarihafshejani, Derek Van Der Kooy, Michael G Fehlings

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Cerebral palsy (CP) is a common neurodevelopmental disorder characterized by pronounced motor dysfunction and resulting in physical disability. Neural precursor cells (NPCs) have shown therapeutic promise in mouse models of hypoxic-ischemic (HI) perinatal brain injury, which mirror hemiplegic CP. Constraint-induced movement therapy (CIMT) enhances the functional use of the impaired limb and has emerged as a beneficial intervention for hemiplegic CP. However, the precise mechanisms and optimal application of CIMT remain poorly understood. The potential synergy between a regenerative approach using NPCs

and a rehabilitation strategy using CIMT has not been explored. We employed the Rice-Vannucci HI model on C57Bl/6 mice at postnatal day (PND) 7, effectively replicating the clinical and neuroanatomical characteristics of hemiplegic CP. NPCs were transplanted in the corpus callosum (CC) at PND21, which is the age corresponding to a 2-year-old child from a developmental perspective and until which CP is often not formally diagnosed, followed or not by Botulinum toxin injections in the unaffected forelimb muscles at PND23, 26, 29 and 32 to apply CIMT. Both interventions led to enhanced CC myelination and significant functional recovery (as shown by rearing and gait analysis testing), through the recruitment of endogenous oligodendrocytes. The combinatorial treatment indicated a synergistic effect, as shown by newly recruited oligodendrocytes and functional recovery. This work demonstrates the mechanistic effects of CIMT and NPC transplantation and advocates for their combined therapeutic potential in addressing hemiplegic CP.

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